Pros and Cons of Alternative Origin-Destination Passive Data Collection Methods

presented by
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Alternative O/D Passive Data Collection

- Background
- Methods
- Pros & Cons
- Acknowledgements
Alternative O/D Passive Data Collection

- Background
  - Polk County Transportation Planning Organization Task Order
  - Stantec experience with methodologies for Traffic & Revenue Studies
  - Author’s prior personal experience with alternate methodologies
  - Vendor contacts, demos, and examples
Alternative O/D Passive Data Collection

• Methods
  – Tag Matching with High Speed Videotaping of License Plates
  – Positioning of Bluetooth Readers to Match Devices
  – Tracking of Anonymous Cellular Data
  – Truck GPS Tracking
  – Aerial Tracking of Vehicles
  – GPS Data Extraction

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Traditional Methods</th>
<th>GPS</th>
<th>Smartphone</th>
<th>License Plate</th>
<th>Bluetooth</th>
<th>Cell Phone</th>
<th>Web-Based</th>
<th>Social Media/Networking</th>
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</thead>
<tbody>
<tr>
<td>Origin-Destination</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Mode: Main/Access/Egress</td>
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<td>Y</td>
<td>Y</td>
<td>Y-auto</td>
<td>Y-auto</td>
<td>Y</td>
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<td>Trip Purpose</td>
<td>Y</td>
<td>M</td>
<td>Y</td>
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<td>N</td>
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<td>Routes</td>
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<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<tr>
<td>Trip Duration</td>
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<td>Y</td>
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<td>Itinerary and Side Tours</td>
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<td>Travel Party Size</td>
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<td>Traveler Characteristics</td>
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<td>Domestic or International</td>
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<td>M</td>
<td>M</td>
<td>M</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
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</tbody>
</table>

Other Considerations

- Passive Data Collection: N Y M M Y Y N M
- Major Privacy Concern: M M M M N N M Y
- High-Respondent Burden: Y M M N N N Y Y
- Sampling Bias: M M M N N Y M Y
- Sufficient Sample Size: M M M Y Y M Y Y

Note: “M” (maybe) implies that although the information cannot be directly collected with a specific technology, it may be estimated based on other data sources and/or data post-processing algorithms.
Alternative O/D Passive Data Collection

• **Methods**
  – Tag Matching with High Speed Videotaping of License Plates
    • Numerous data collection firms have needed equipment
    • Videotaping of license tags along cordon line; typically one camera per lane
    • Transcription of license tags into a database
    • Matching of tags passing through multiple points, during a specified duration
    • Simultaneous traffic counts to identify percent of trips captured by video
    • Optionally, using tag information to contact vehicle owners to participate in follow-up survey (*no longer passive*)
• Methods

  – Positioning of Bluetooth Readers to Match Devices
    • Numerous data collection firms have needed equipment – purchase or leasing of Bluetooth readers
    • Permanently affix Bluetooth readers for continuous tracking or install temporarily for specific study
    • Anonymous identification of Bluetooth devices that pass through 2 or more points in a specified period of time
    • Simultaneous traffic counts to identify percent of trips captured via Bluetooth readers
• Methods
  – Tracking of Anonymous Cellular Data (AirSage)
    • AirSage has contracts with two major U.S. cellular providers to continuously retrieve and analyze anonymous cellular devices
    • Algorithms are used to triangulate locations of each device
    • Data retrieval can occur at multiple locations along the path the device is following
    • Flexibility to analyze the data by number of days, days of the week, different locations and study areas, etc. though AirSage has established minimum number of days threshold
• Methods
  – Truck GPS Tracking (ATRI)
    • Outgrowth of American Transportation Research Institute’s research for the nation’s trucking industry
    • Continuous tracking and collection of a sample of truck GPS signals
    • Similar to AirSage, data retrieval can occur at multiple locations along the path the device is following
    • Flexibility to analyze data by number of days, days of the week, different study areas and corridors, etc.
    • FDOT, with assistance from USF, has purchased and analyzed ATRI data for the state of Florida and estimated truck origin-destination matrices using these data
• Methods
  – Aerial Tracking of Vehicles (Skycomp)
    • Skycomp deploys aircraft to take high definition aerial photos of traffic in a specified study area
    • Photos are subsequently analyzed by Skycomp staff to trace travel patterns of individual vehicles
    • Skycomp then prepares an estimated origin-destination matrix and distribution percentages among multiple entry and exit points
• Methods
  – GPS Data Extraction (Streetlight Data)
    • Streetlight Data has partnered with INRIX to use their database of GPS navigation data
    • While INRIX uses these data for estimating travel speeds, Streetlight Data uses these same data for origin-destination matrix estimation
    • Since commercial fleet navigation systems use different technologies from personal vehicles, trips can be differentiated by vehicle type (auto vs. truck)
• Pros & Cons
  – Tag Matching with High Speed Videotaping of License Plates
  – Positioning of Bluetooth Readers to Match Devices
  – Tracking of Anonymous Cellular Data
  – Truck GPS Tracking
  – Aerial Tracking of Vehicles
  – GPS Data Extraction
• Pros & Cons
  – Tag Matching with High Speed Videotaping of License Plates
    • Pros: collection of license tag data does allow for subsequent survey analysis (e.g., sending out a subsequent postcard survey with help of DMV)
    • Cons: Videotaping and matching of license tags is potentially expensive and cumbersome
Alternative O/D Passive Data Collection

• Pros & Cons
  – Positioning of Bluetooth Readers to Match Devices
    • Pros: Bluetooth data collection does allow for the flexibility of one time use or continuous data collection at established sites at a lower cost than videotaping plates
    • Cons: Matching Bluetooth movements is still limited to enabled devices and unlike cellular flows, Bluetooth is limited to locations where readers are located
• Pros & Cons
  – Tracking of Anonymous Cellular Data (AirSage)
  • Pros: The cost of AirSage data is very inexpensive with a flexible pricing calculator to further refine the data budget and coverage is only limited by cellular provider market penetration
  • Cons: AirSage data only includes two national cellular carriers and thus could be somewhat biased and it is nearly impossible to distinguish vehicle type, travel mode, etc.
• Pros & Cons

– Truck GPS Tracking (ATRI)
  • Pros: As a not for profit research center, the cost of ATRI truck GPS data is inexpensive with a willingness to meet tight budgets
  • Cons: ATRI GPS data are limited to a sample of trucks only
• Pros & Cons
  – Aerial Tracking of Vehicles (Skycomp)
    • Pros: Skycomp provides a permanent record and also processes data into origin-destination matrices and images of distribution patterns so post-processing is unnecessary
    • Cons: Cost of data collection and extraction can get expensive with multiple dates and time periods
• Pros & Cons
  – GPS Data Extraction (Streetlight Data)
    • Pros: StreetLight Data is powered by INRIX GPS data so its metrics are based on an unusually large sample size and data can distinguish between autos and trucks
    • Cons: Cost of data extraction can get expensive for a large no. of zones and while less expensive in most cases, StreetLight Data are not as precise as aerial photo tracing (precision issues can be problematic along roadways with extreme congestion, sharp curvature, or dense street patterns)
• Acknowledgements
  – Polk County TPO
  – Kimley Horn Associates (TPO on-call prime)
  – NCHRP 735
  – AirSage
  – All Traffic Data
  – ATRI
  – TrafficCast (BlueTOAD)
  – Skycomp
  – Street Light Data
### Alternative O/D Passive Data Collection

**Questions?**

<table>
<thead>
<tr>
<th>Unique Characteristics of Methodology</th>
<th>High speed videotaping of license plates</th>
<th>Positioning of Bluetooth readers to match devices</th>
<th>Tracking of anonymous cellular data</th>
<th>Truck GPS tracking</th>
<th>Aerial tracking of vehicles</th>
<th>Tracking of multiple GPS device types</th>
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<tbody>
<tr>
<td>Vendor/Product Names (where applicable)</td>
<td>n/a</td>
<td>TrafficCast BlueToad</td>
<td>AirSage</td>
<td>ATRI</td>
<td>SkyComp</td>
<td>StreetLight Insight</td>
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<tr>
<td>General Description of Survey Approach</td>
<td>Tracking of vehicles by plate using videotaping</td>
<td>Tracking of vehicles using Bluetooth readers</td>
<td>Tracking of anonymous mobile devices</td>
<td>Tracking movement of trucks via GPS</td>
<td>Tracking vehicles using aerial photography</td>
<td>Tracking vehicles using GPS navigation data</td>
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<tr>
<td>Survey Sampling Unit</td>
<td>Vehicles</td>
<td>Bluetooth Device</td>
<td>Cellular Devices</td>
<td>Truck with GPS</td>
<td>Vehicles</td>
<td>Vehicles with GPS</td>
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<tr>
<td>Survey Period Typically Covered</td>
<td>Single trip (poss. followup survey)</td>
<td>Single trip (poss. tracking of day)</td>
<td>Single trip (poss. tracking of day)</td>
<td>Series of linked truck trips</td>
<td>Single trip within limited study area</td>
<td>Single trip (poss. tracking of day)</td>
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<tr>
<td>Relative Vintage of Approach</td>
<td>Well Established</td>
<td>Relatively Recent</td>
<td>Relatively Recent</td>
<td>Relatively Recent</td>
<td>Relatively Recent</td>
<td>Relatively Recent</td>
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<tr>
<td>Pros/Benefits to Approach</td>
<td>Can be first step in detailed survey</td>
<td>Flexibility to move or station readers</td>
<td>Very inexpensive; easy to self price</td>
<td>Inexpensive and flexible pricing</td>
<td>Creates permanent record</td>
<td>Piggybacked onto INRIX GPS data</td>
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<tr>
<td>Cons/Disadvantages of Approach</td>
<td>The most costly passive option</td>
<td>Requires equip. purchase or lease</td>
<td>Limited to two cellular carriers</td>
<td>Only a sample; mode limited</td>
<td>Potentially costly; small study area</td>
<td>Some issues with precision</td>
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<tr>
<td>Other</td>
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<td>Relative Cost</td>
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